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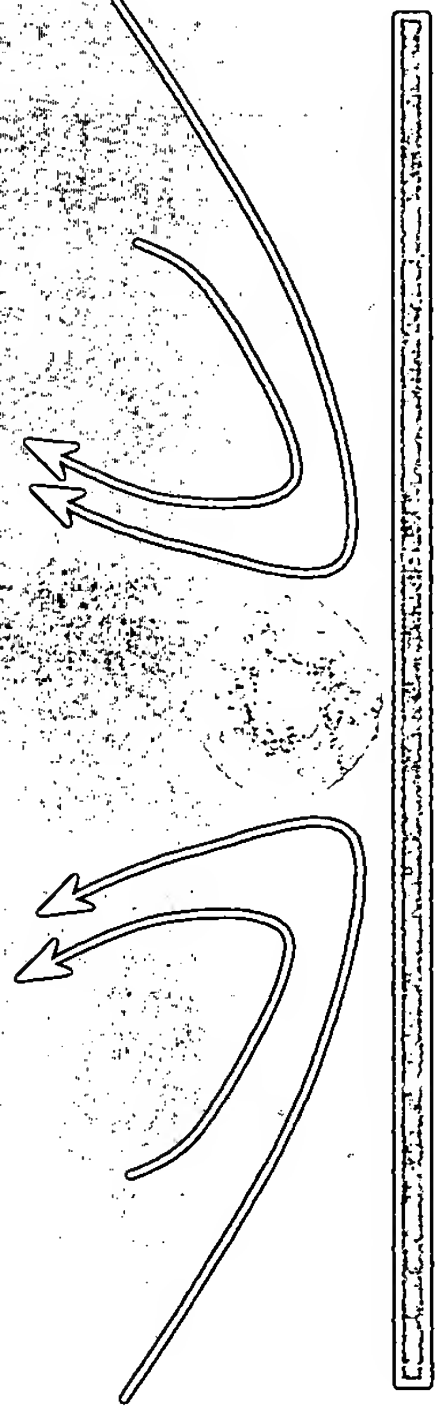
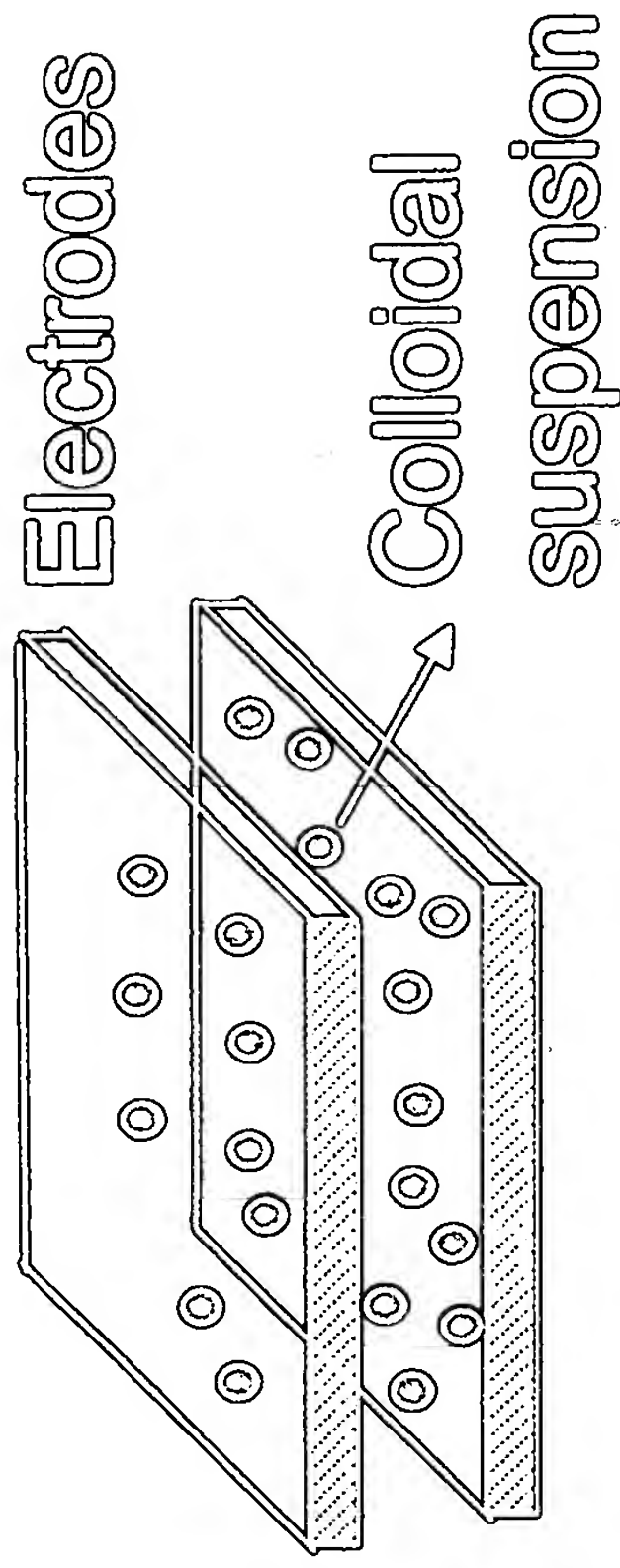
BioArray Solutions

2-D Array Assembly Using Light and Interfacial Patterning

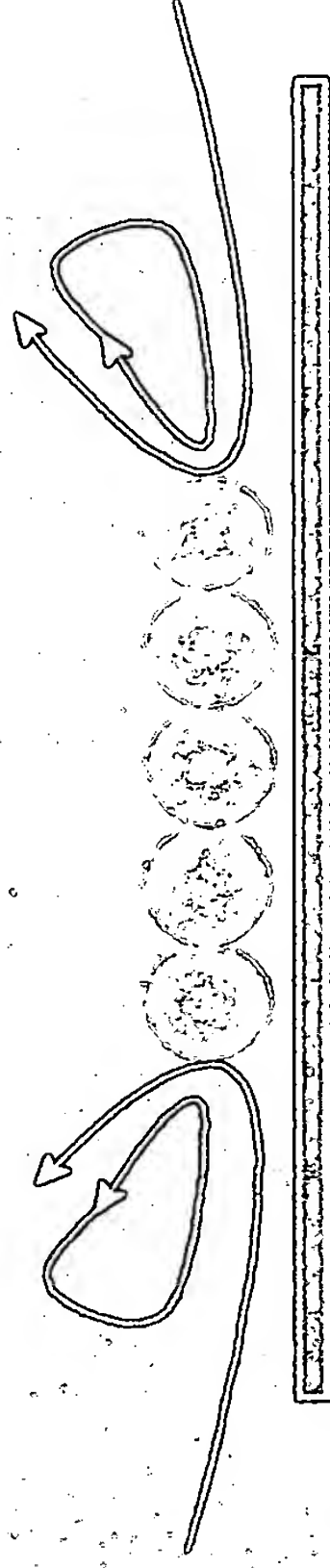
Michael Seul, Sukanta Banerjee, Kairali Podual, Alice Li, Chiu Chau

BioArray Solutions
120 Centennial Avenue
Piscataway, NJ 08854
www.BioArrays.com

Field Induced Crystallization



Axially symmetric toroidal flow field



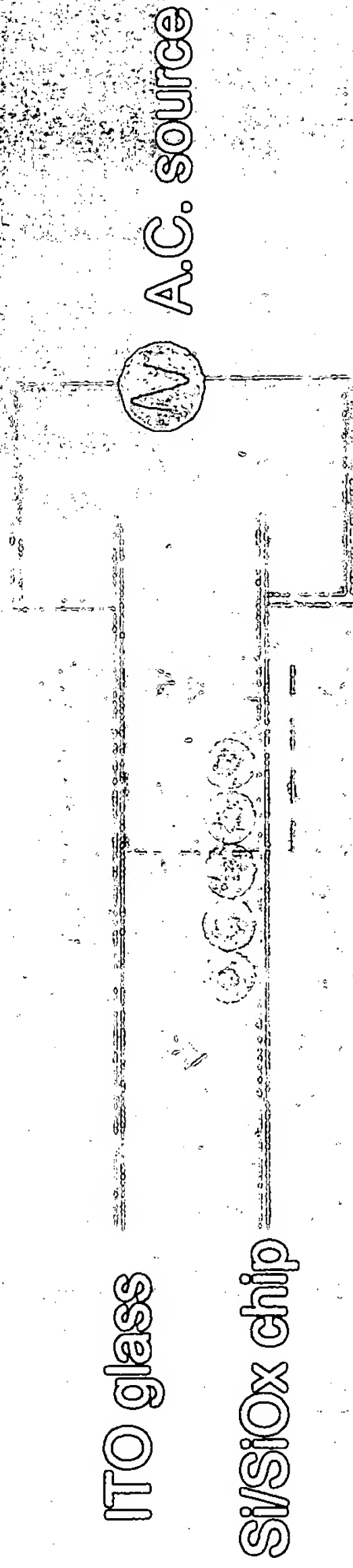
2-D crystallization

Richetti, F., Prost, J., and Barois, P. J.
Phys. Lett. 45, L1137-L1143(1984)

Yeh, S., Seul, M., and Shraiman, B. I.
Nature, 386, 57-59 (1997)

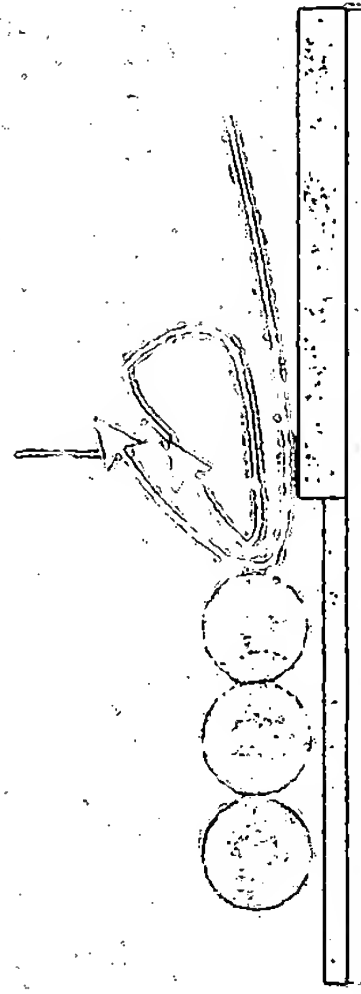
LEAPS

Light - Controlled Electrokinetic Assembly of Particles Near Surfaces

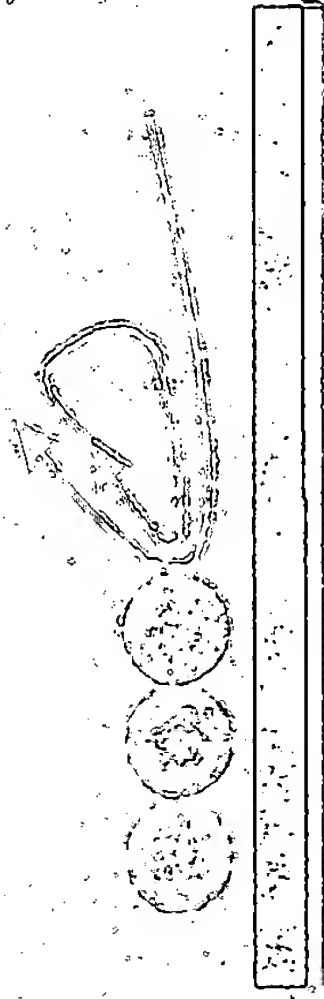


ITO glass

Si/SiO₂ chip



Interfacial patterning

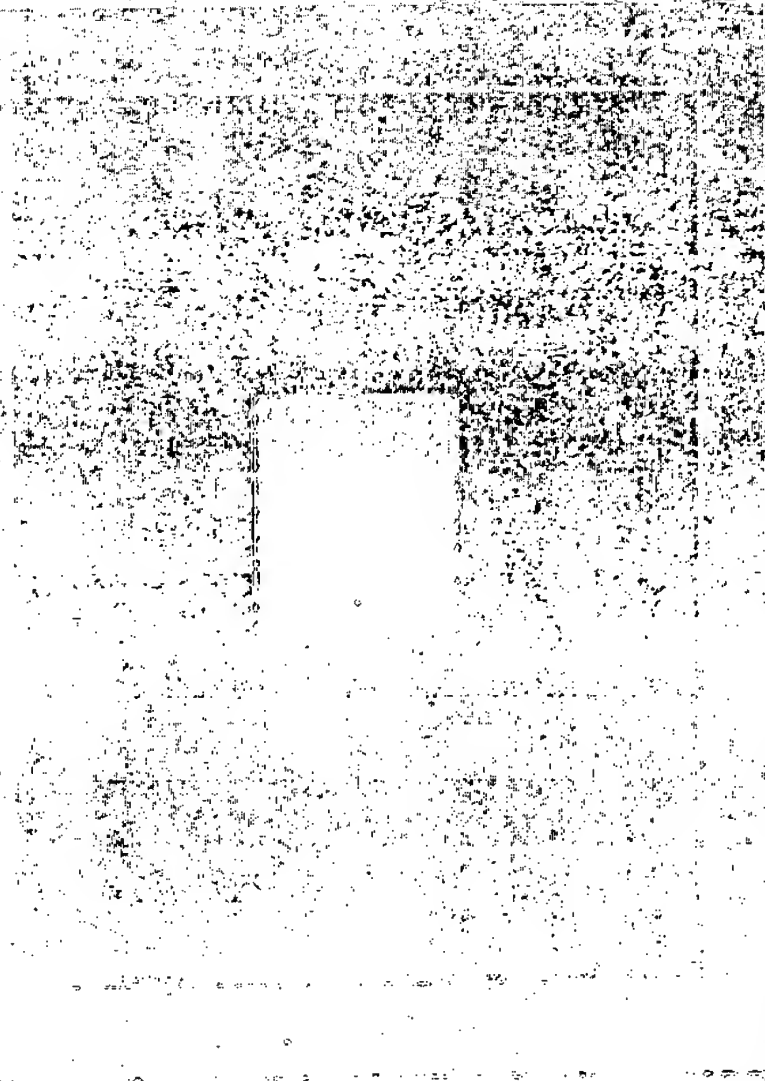
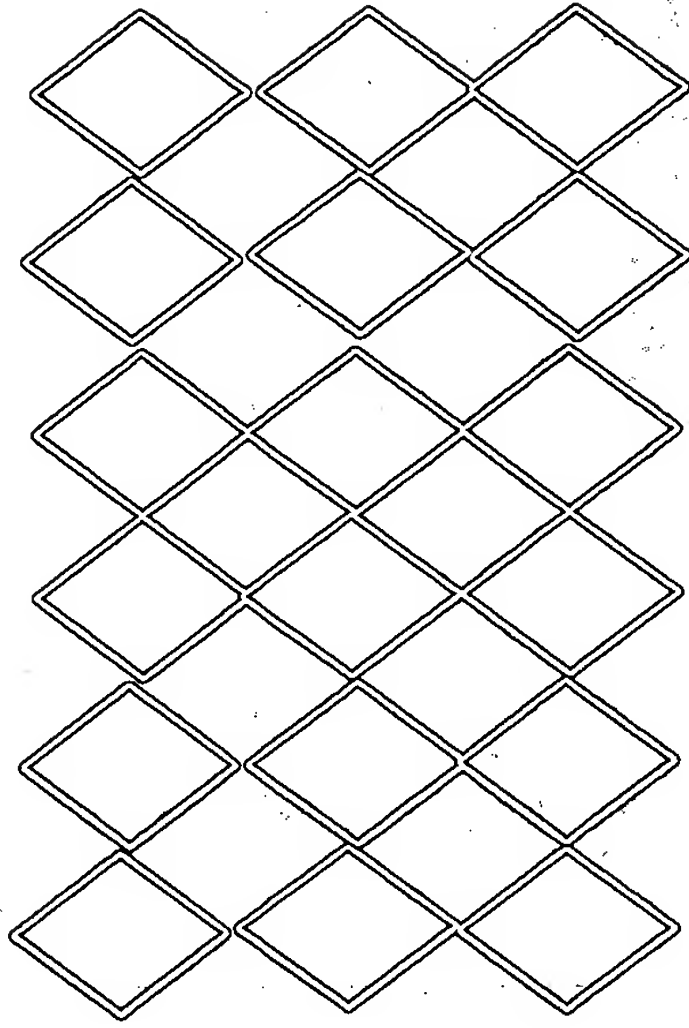


Light patterning

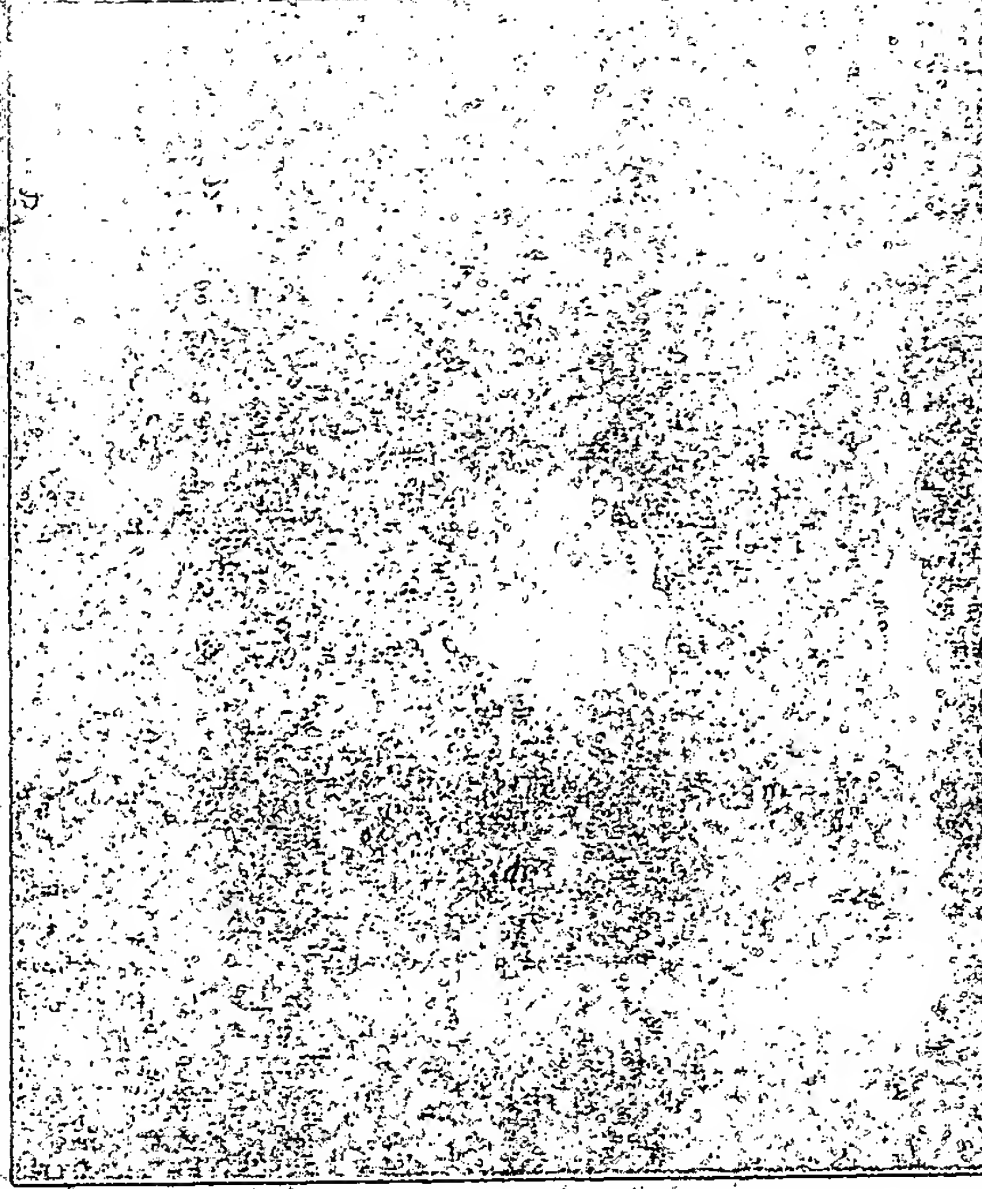
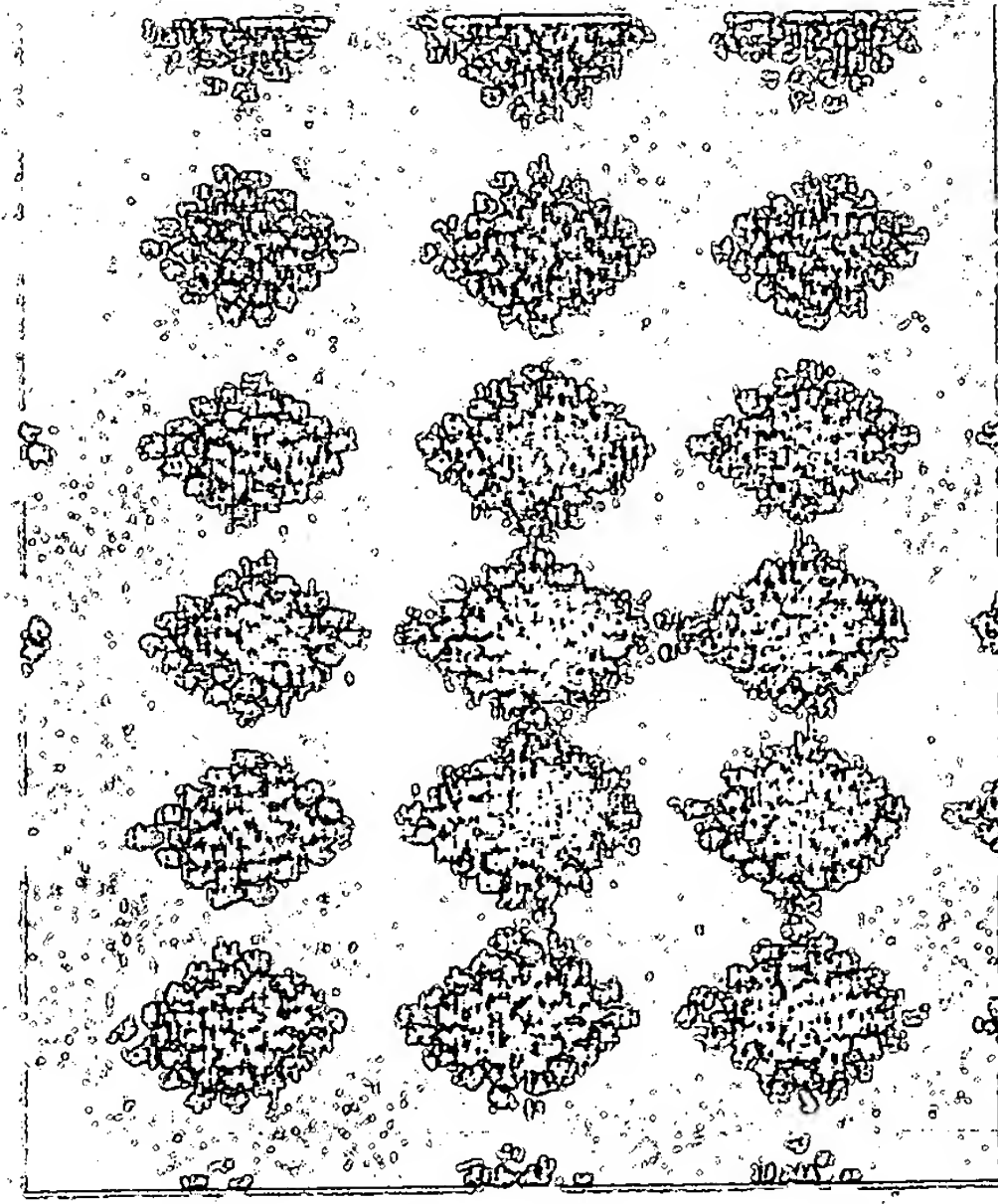
Seul, M. WO 97/40385

Light Patterning

Mask



Assembly



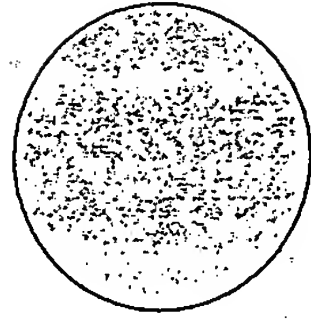
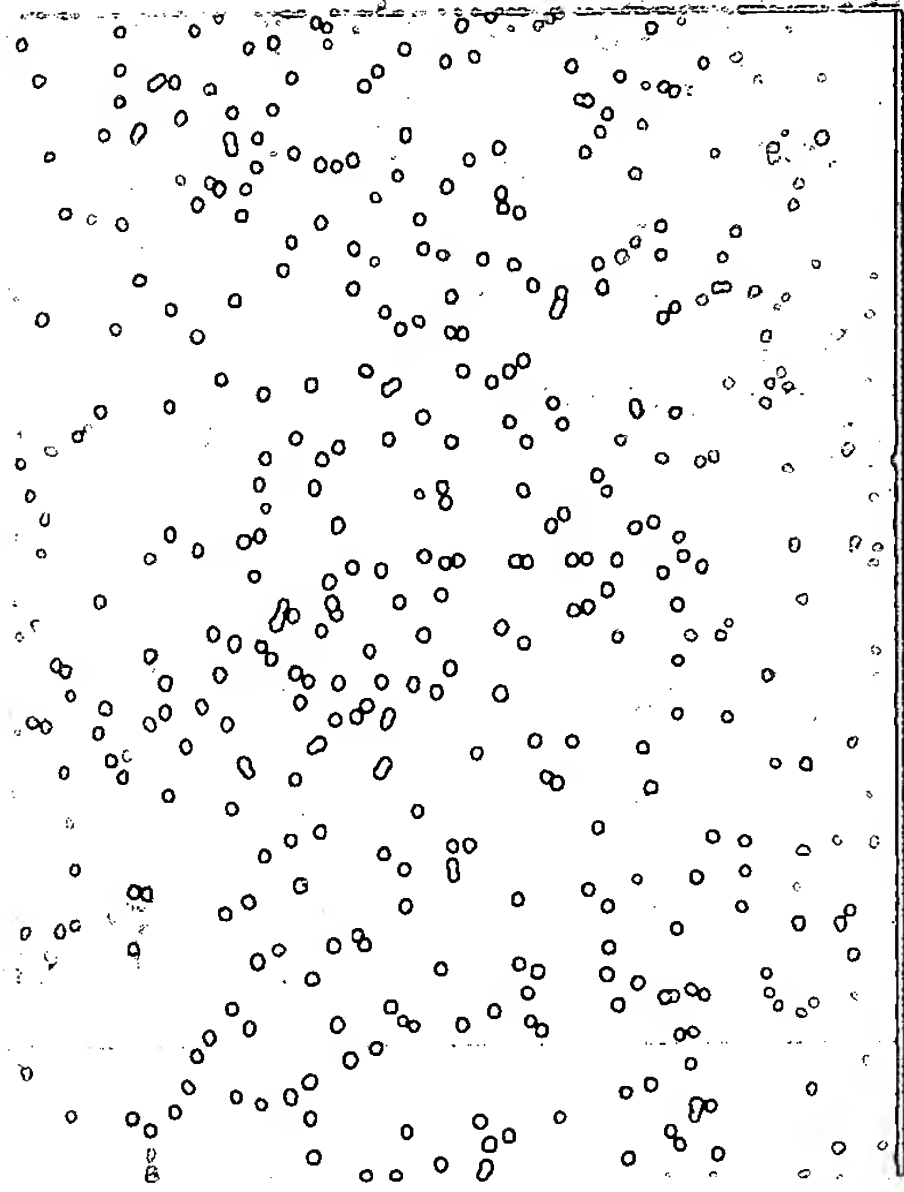
Modeling of LEAPS

- Electrode-Insulator-Semiconductor (EIS) Interface
- Electric Field Distribution
- AC Electro Osmotic Flow (EOF)
- Bead Polarization
- Equation of Motion

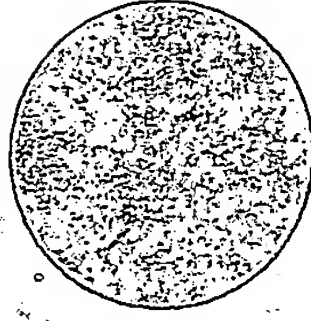
Sorting by Size



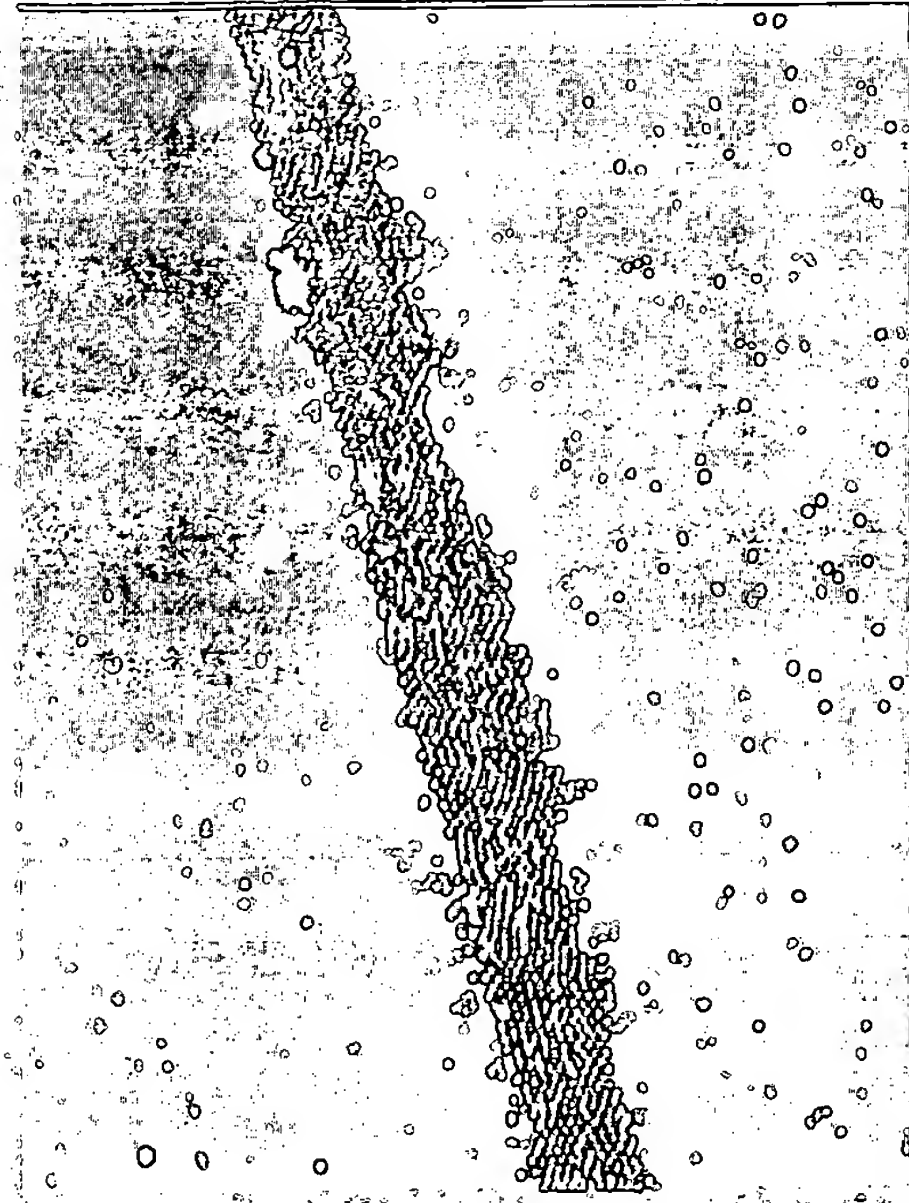
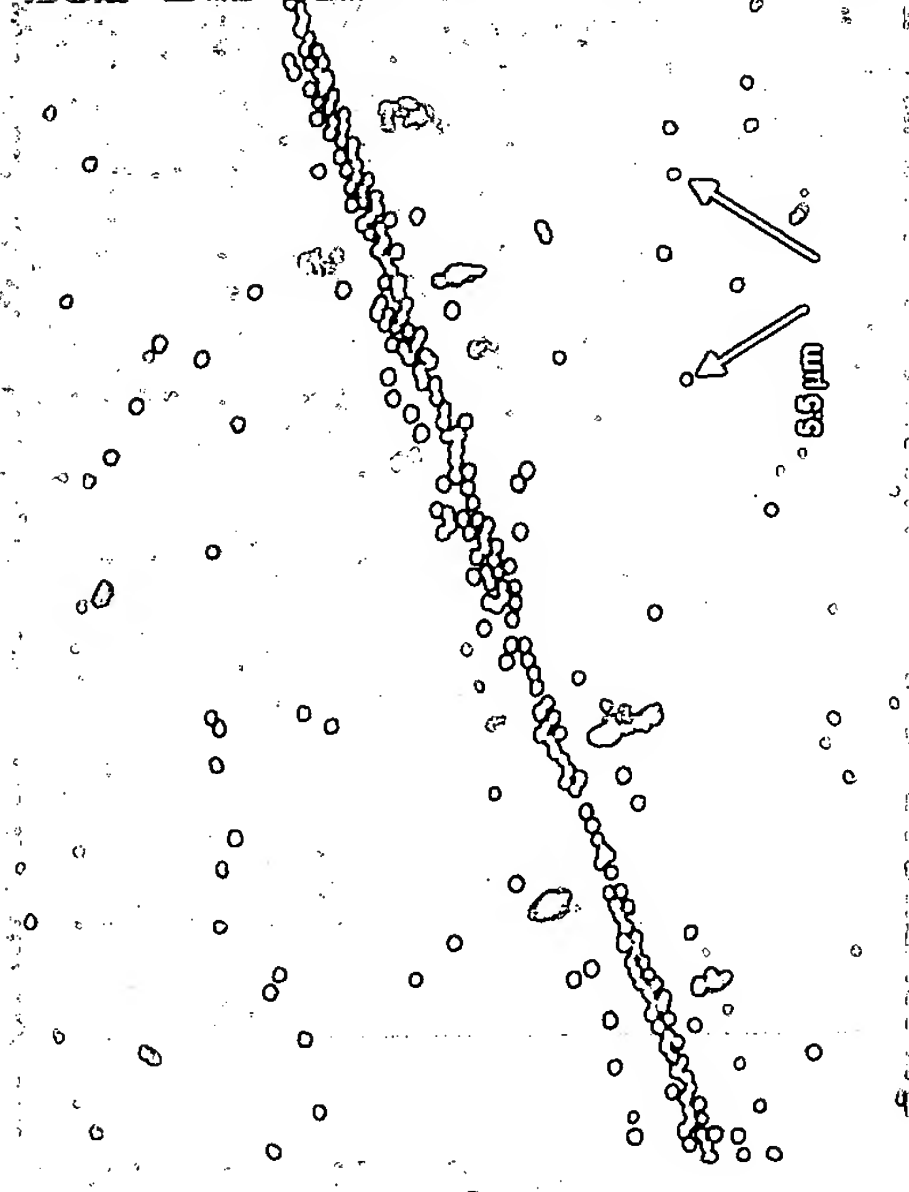
Sorting by Polarizability



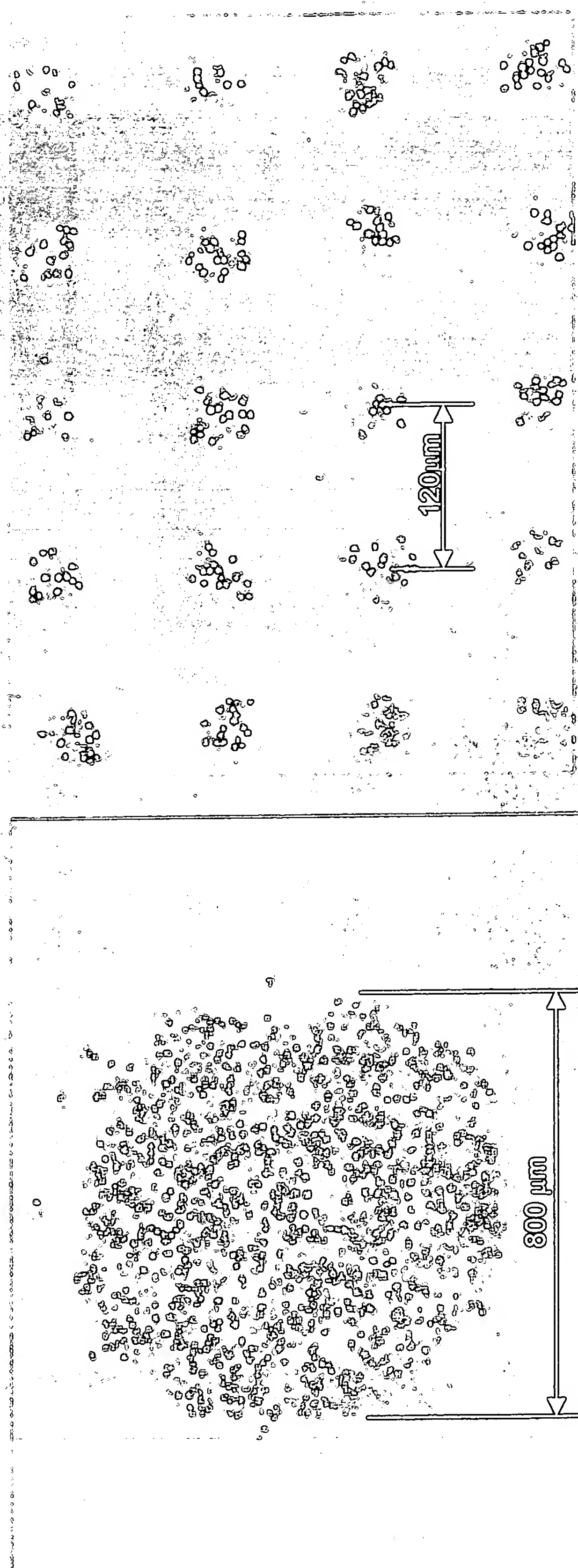
Carboxylated 5.5µm particle



Protein conjugated 5.5µm particle

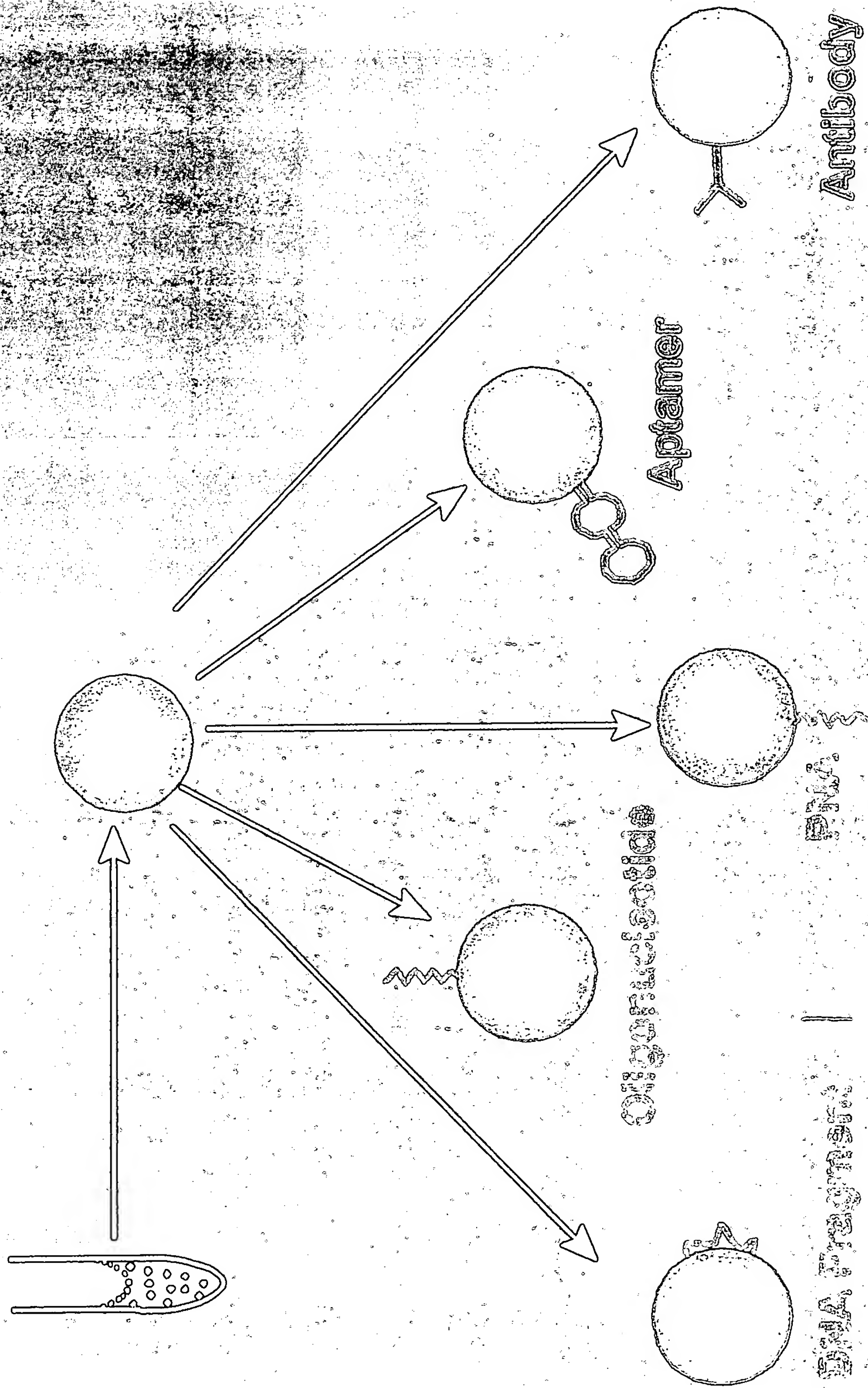


Random Encoded Array Assembly



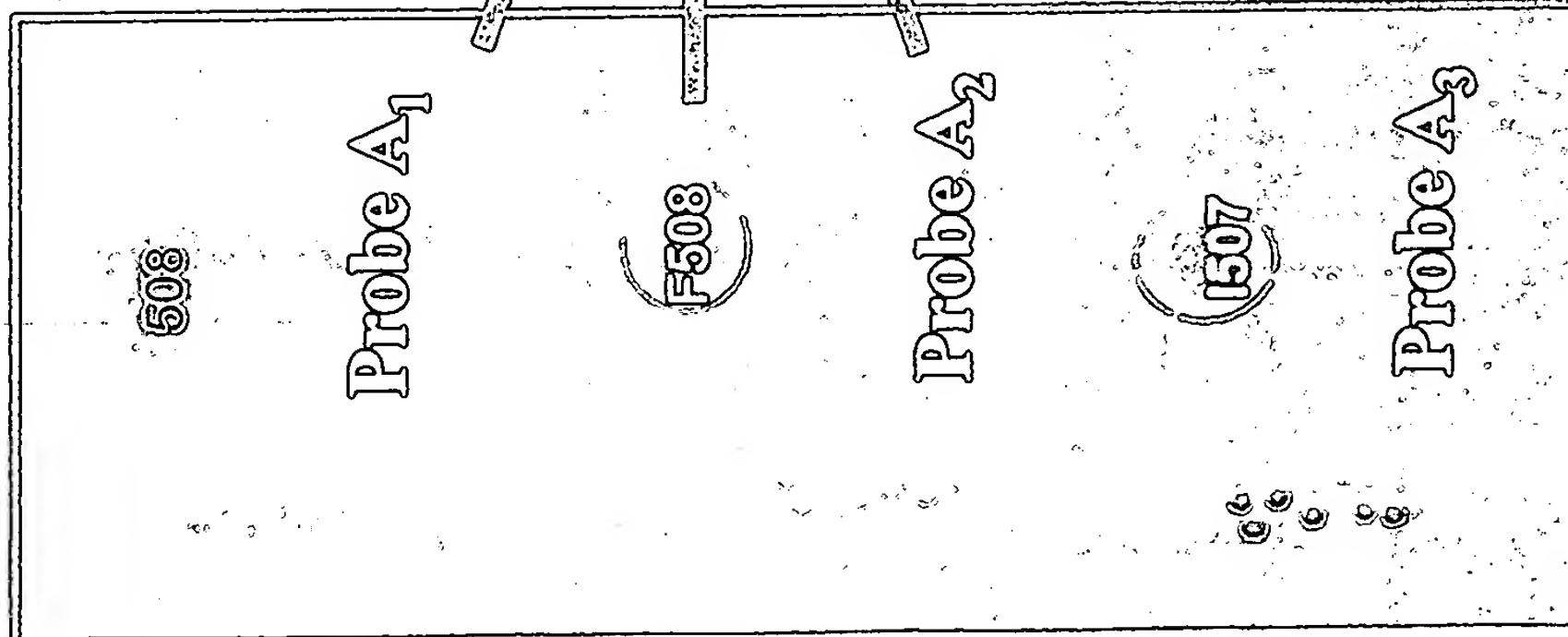
Functionalization

Multifunctionality



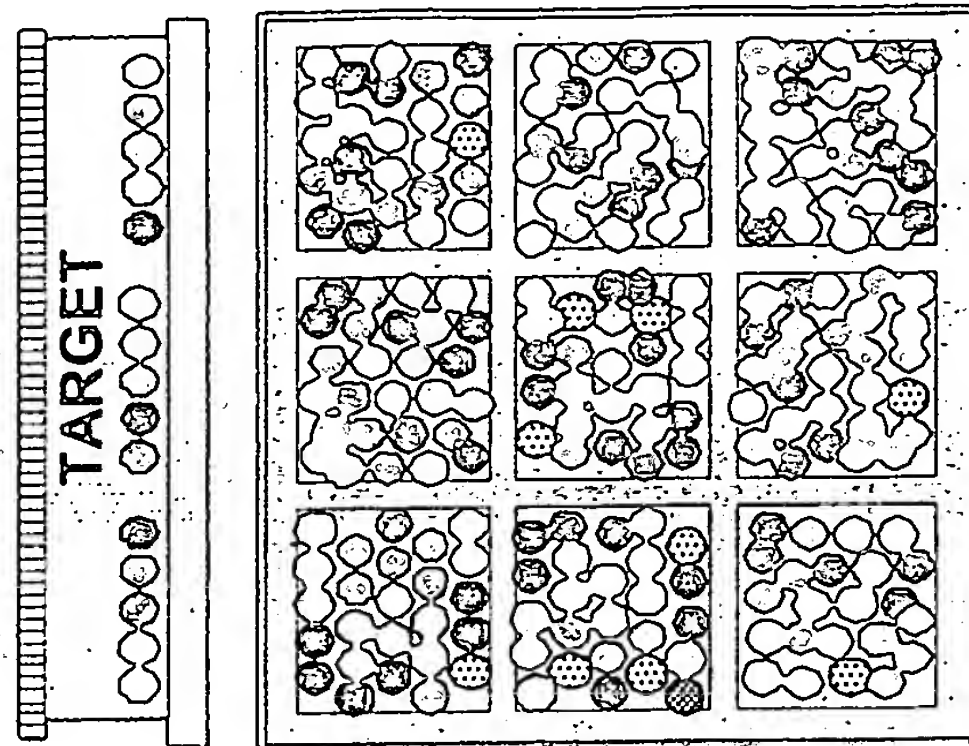
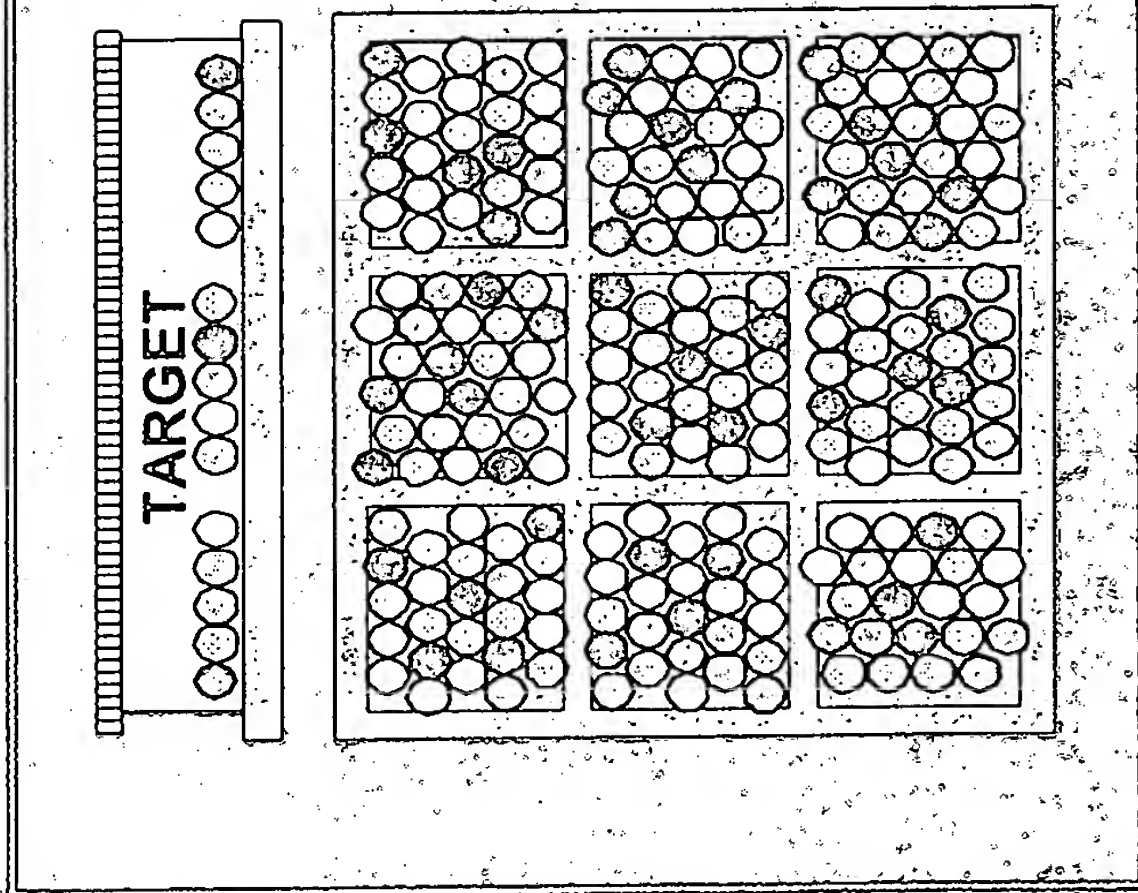
READ

Random Encoded Array Detection

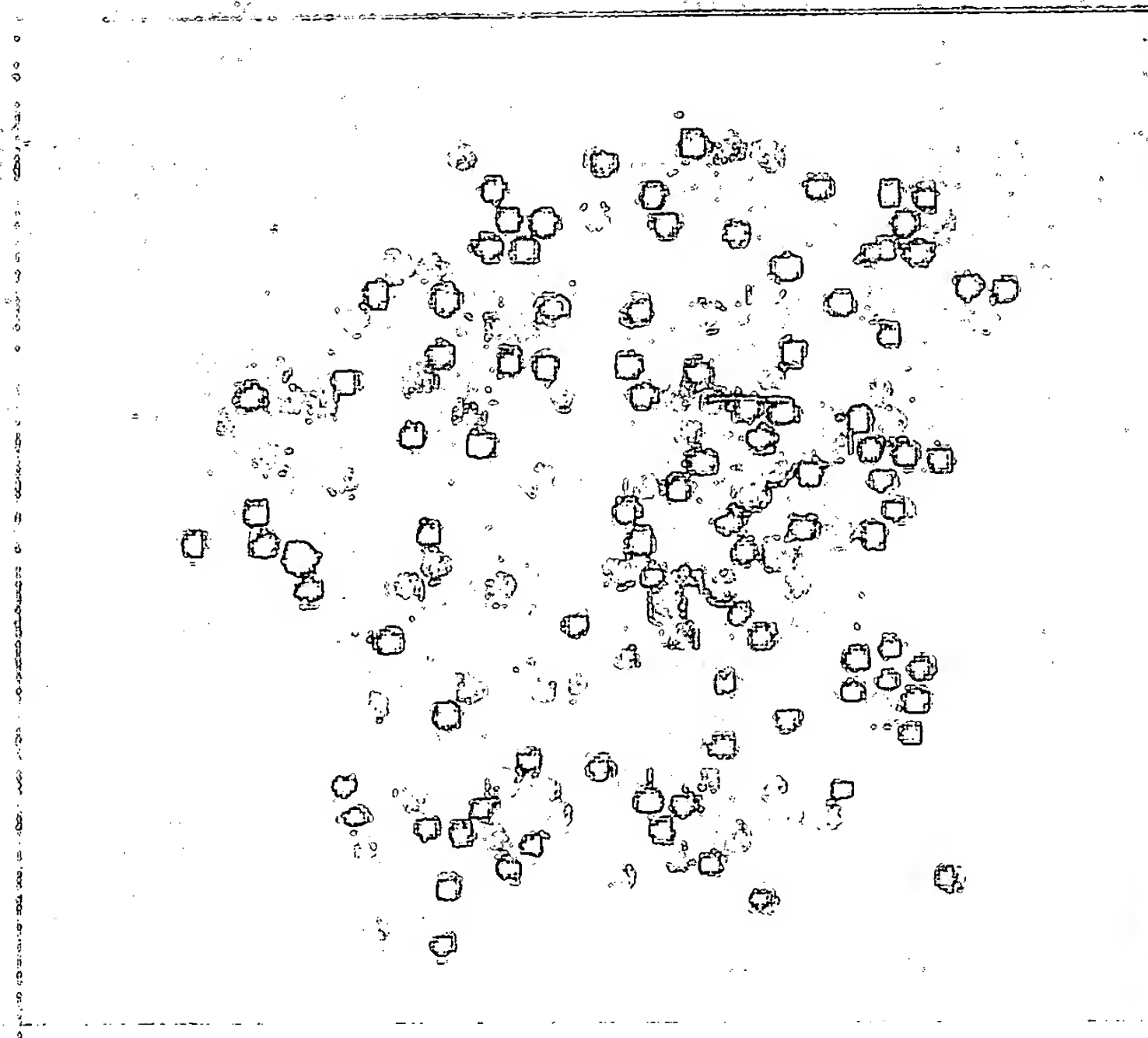
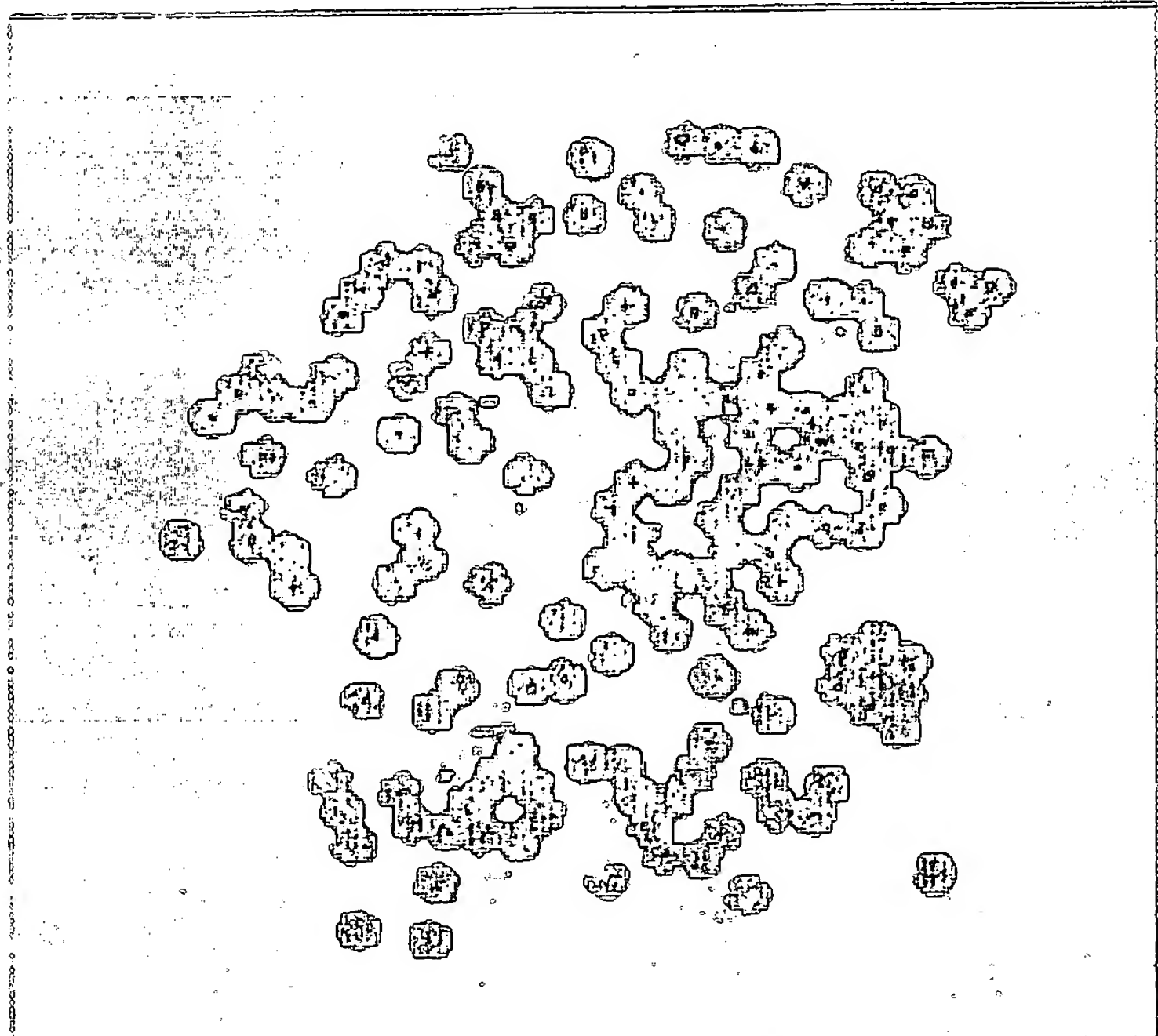


Assay Image

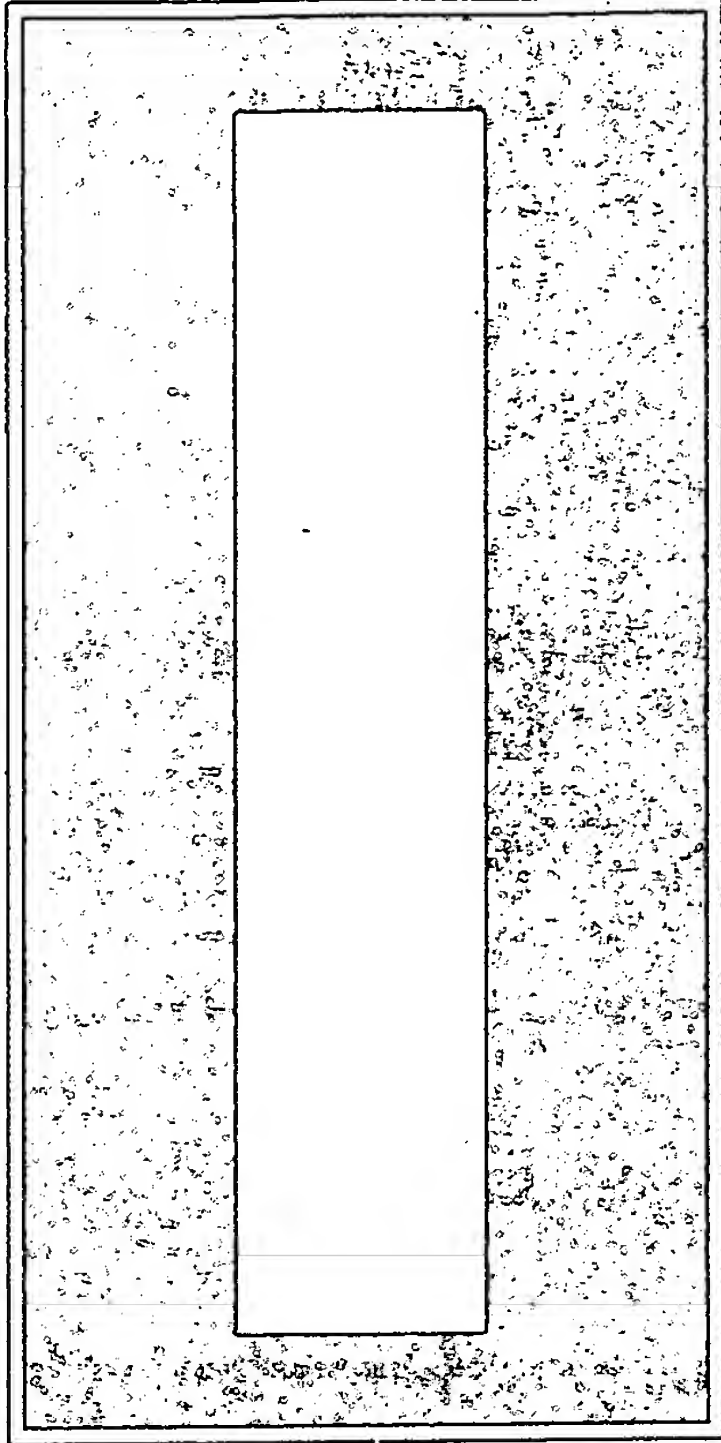
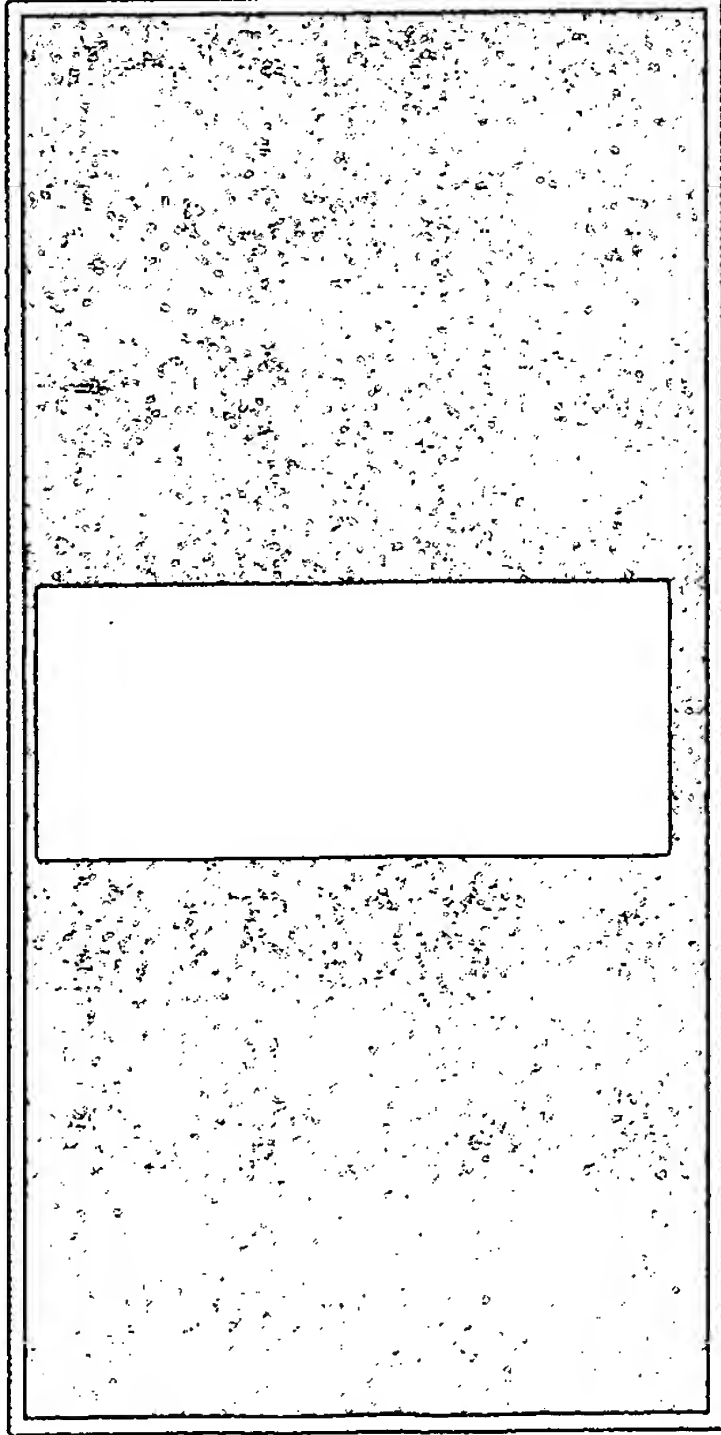
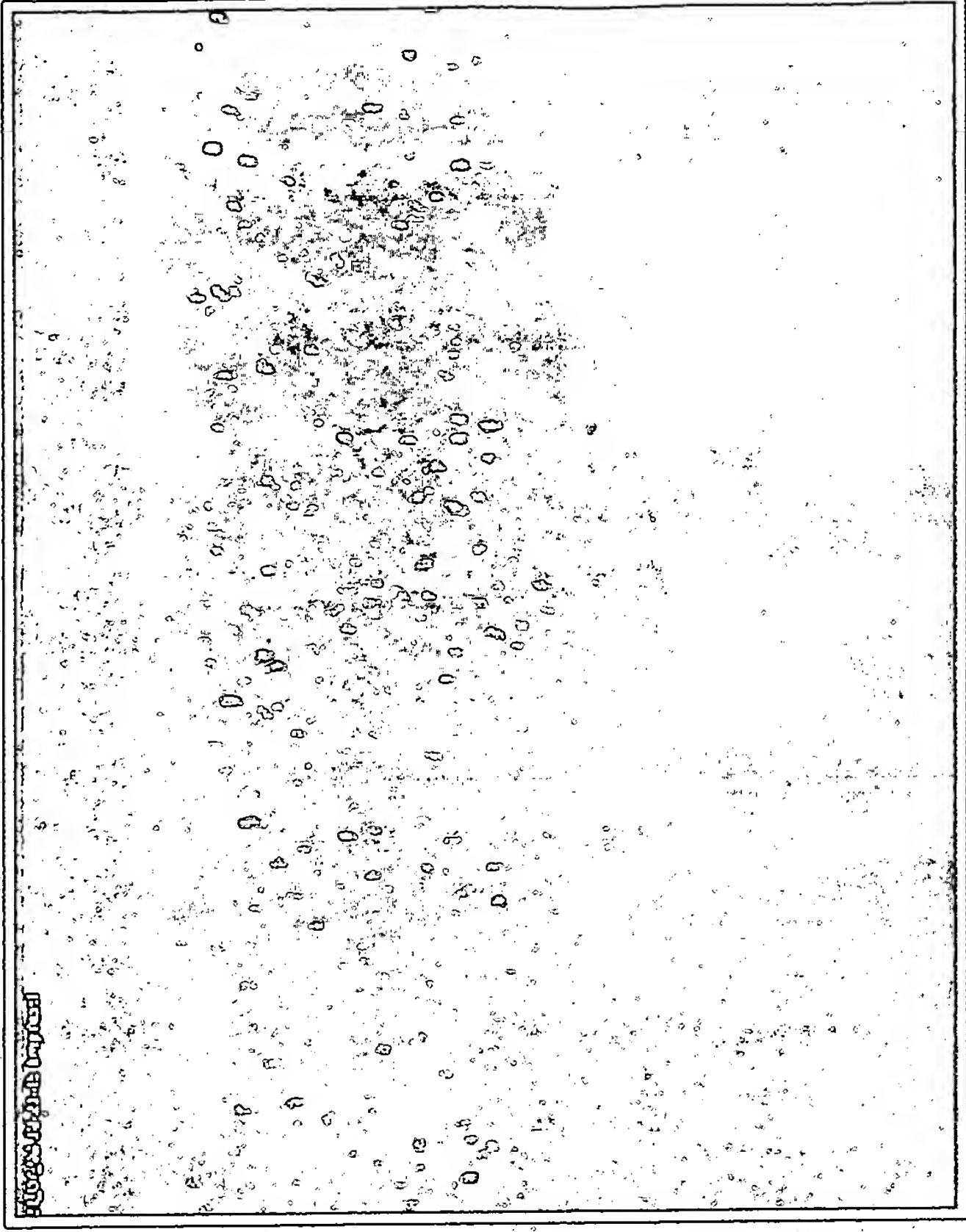
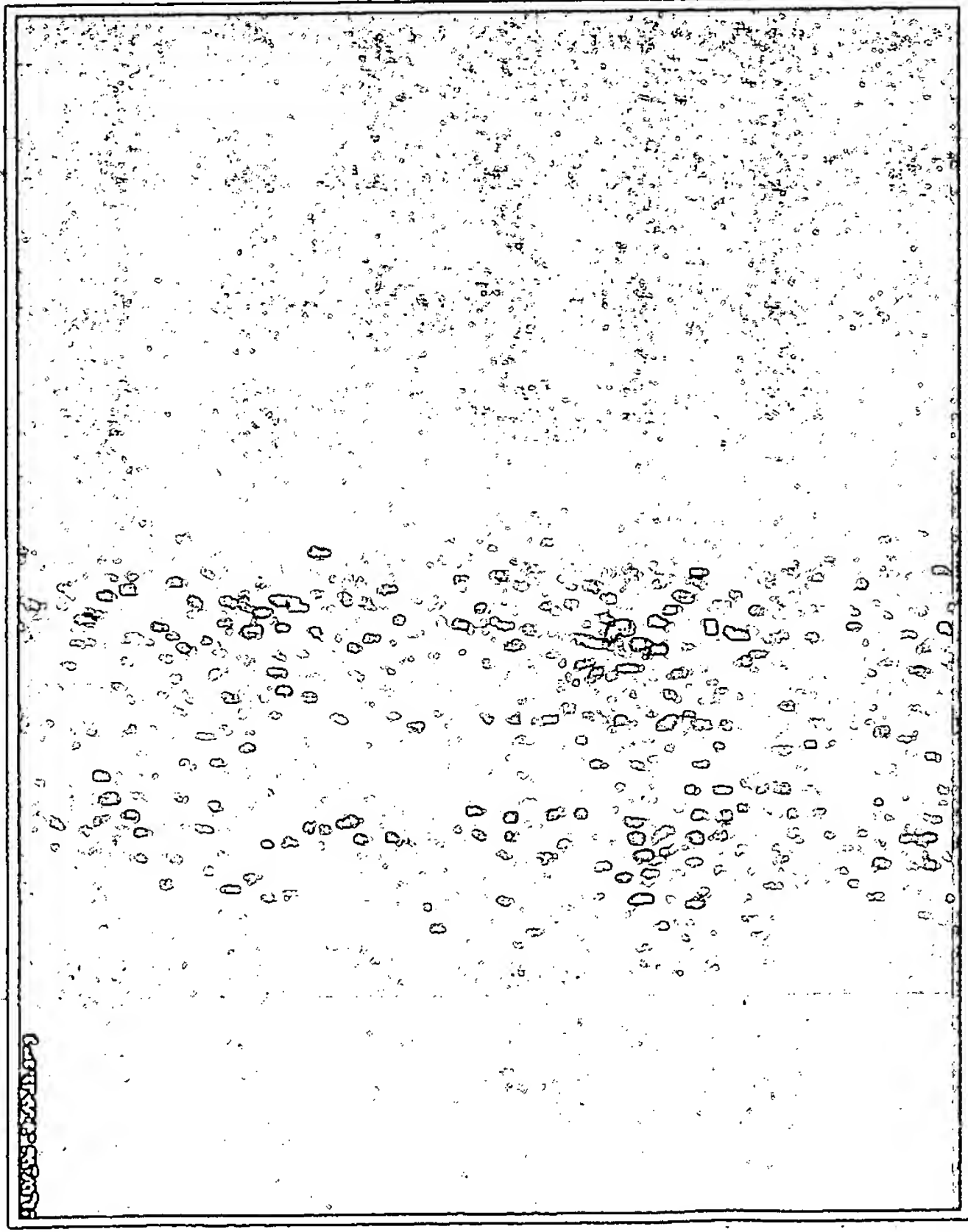
Decoding Image



BioArrays



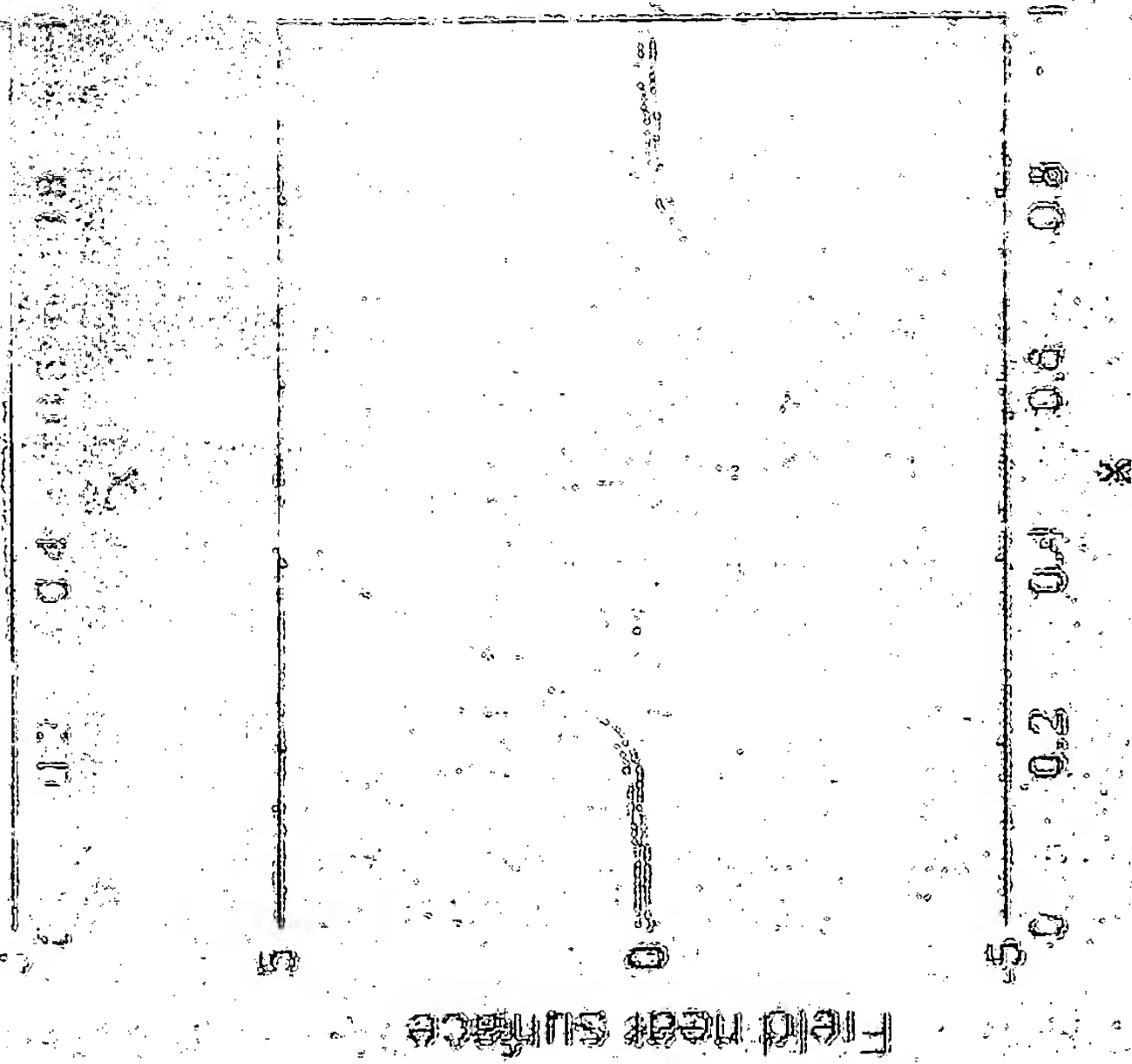
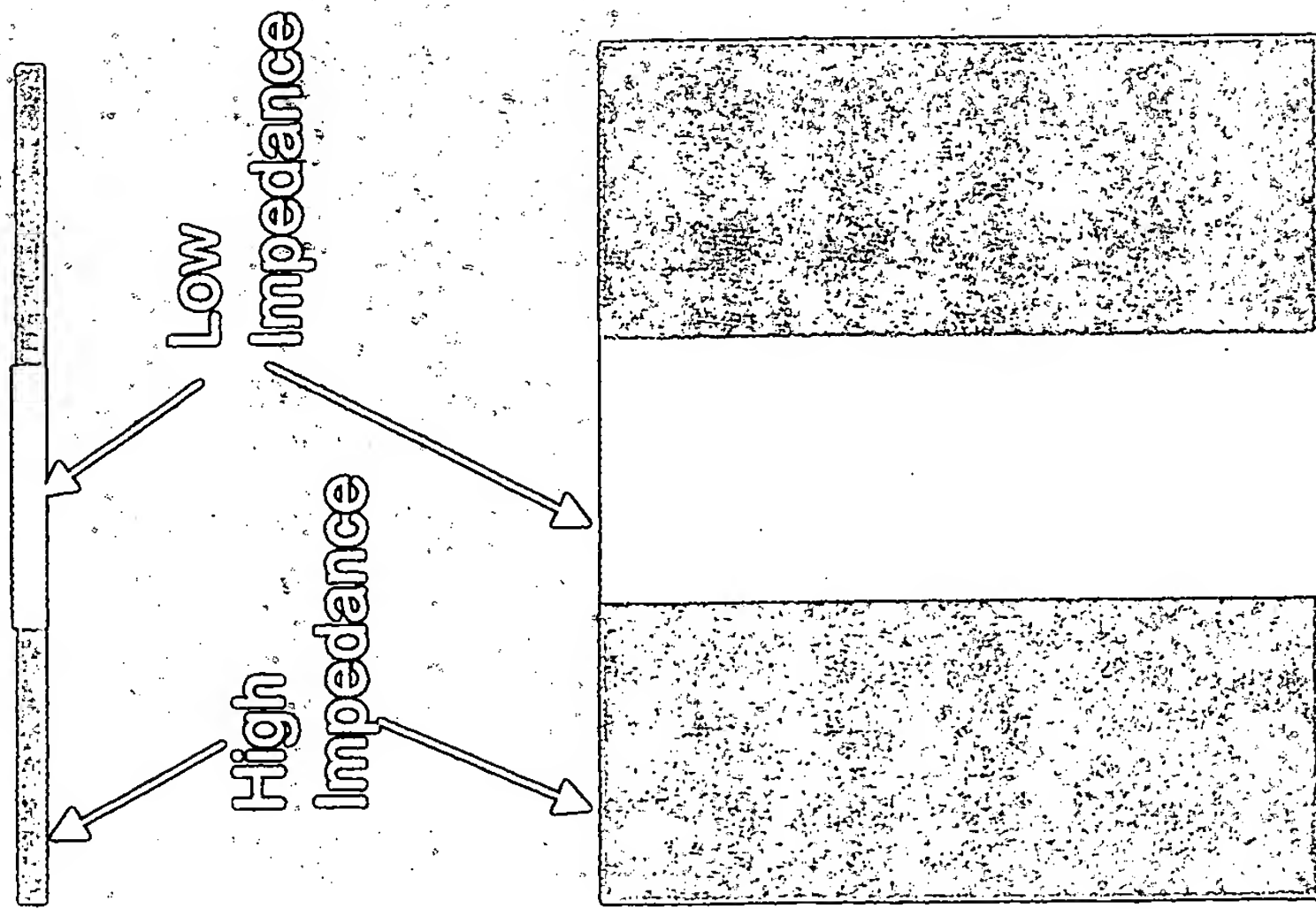
LIGHT-GUIDED YEAST CELL ARRAYS



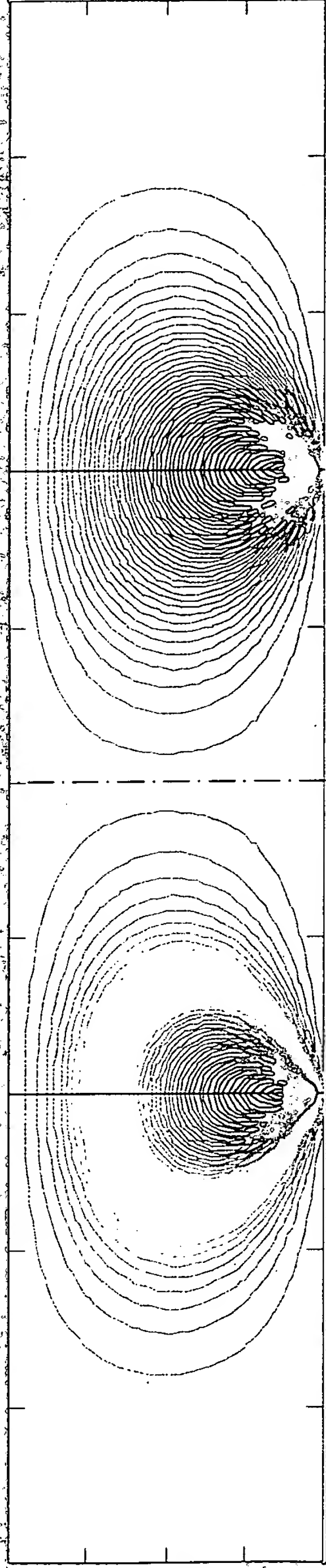
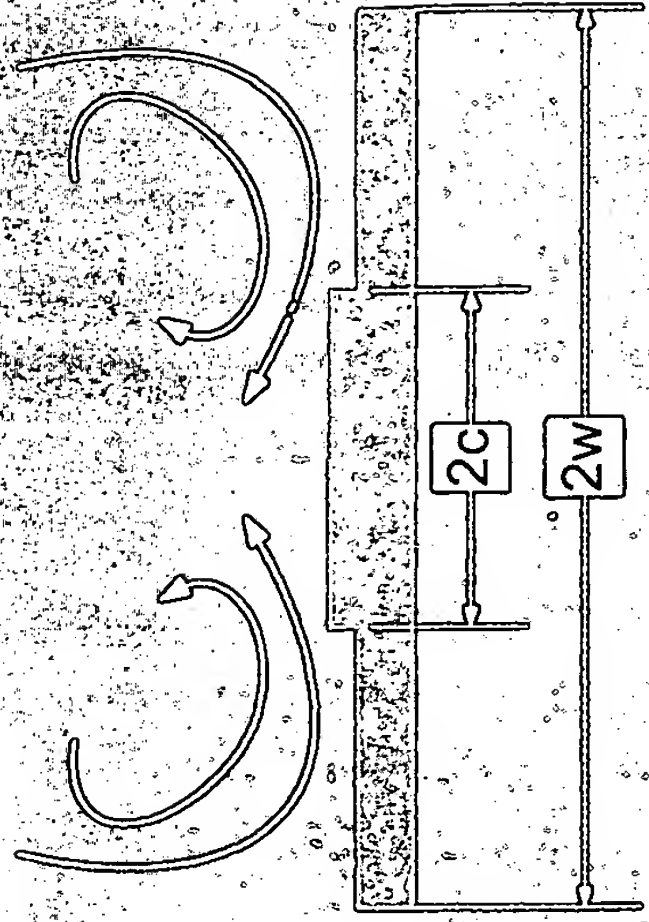
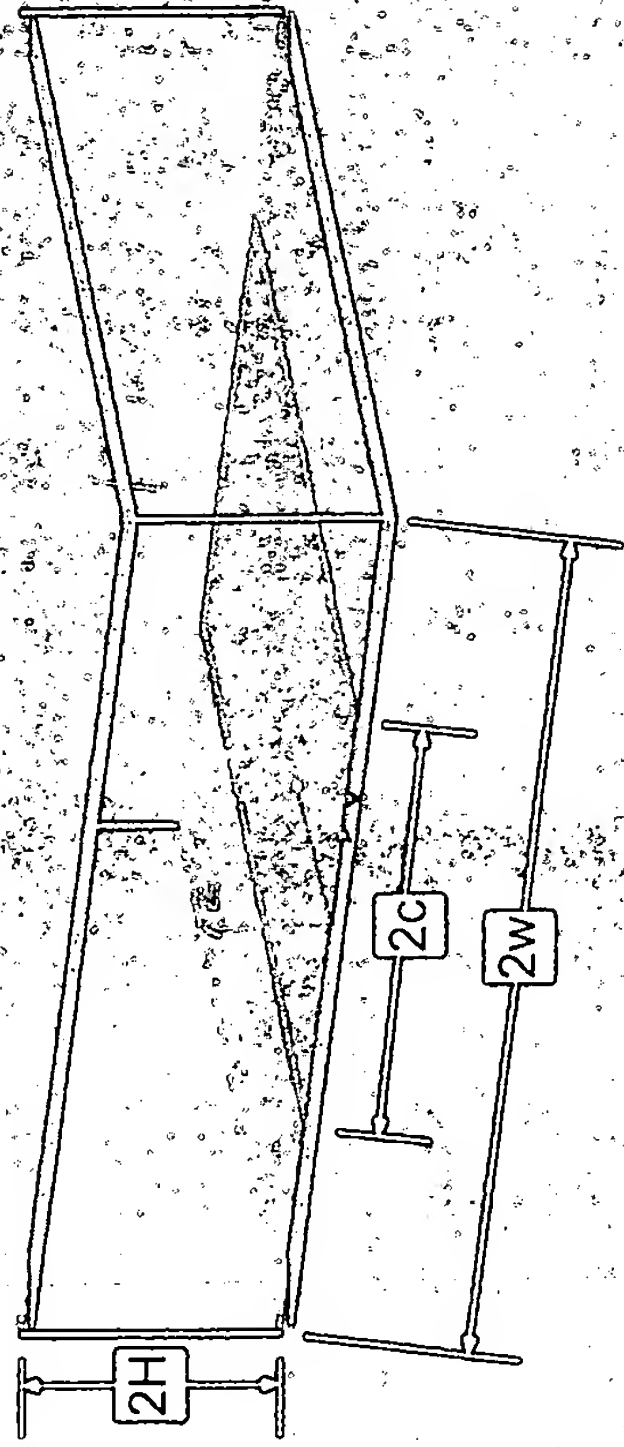
Conclusions

- Optically programmable array assembly and reconfiguration
- Customized microparticle arrays
 - DNA chip
 - Protein chip
- Advanced on-chip Cellular Analysis

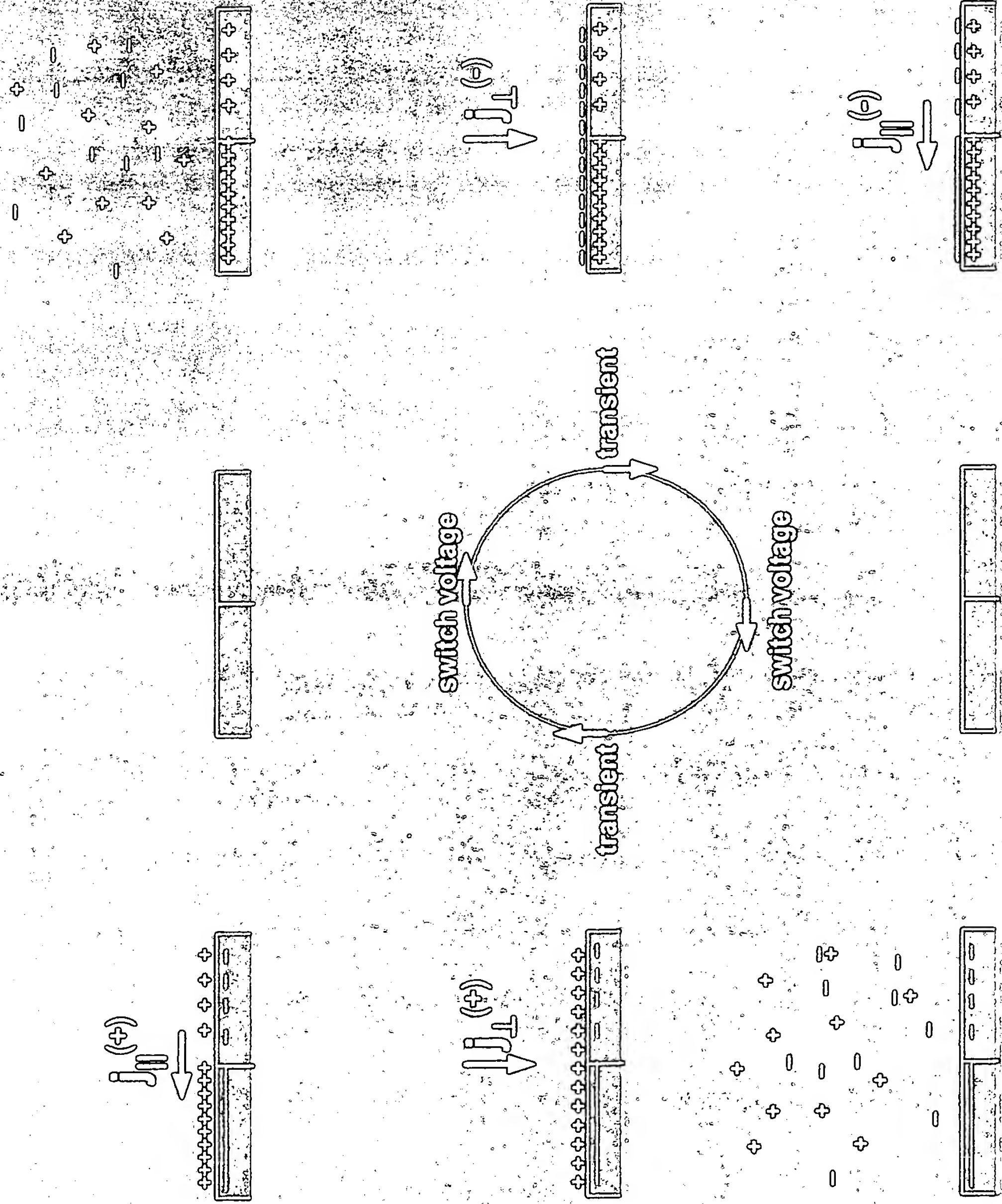
Electric Field Near Surface



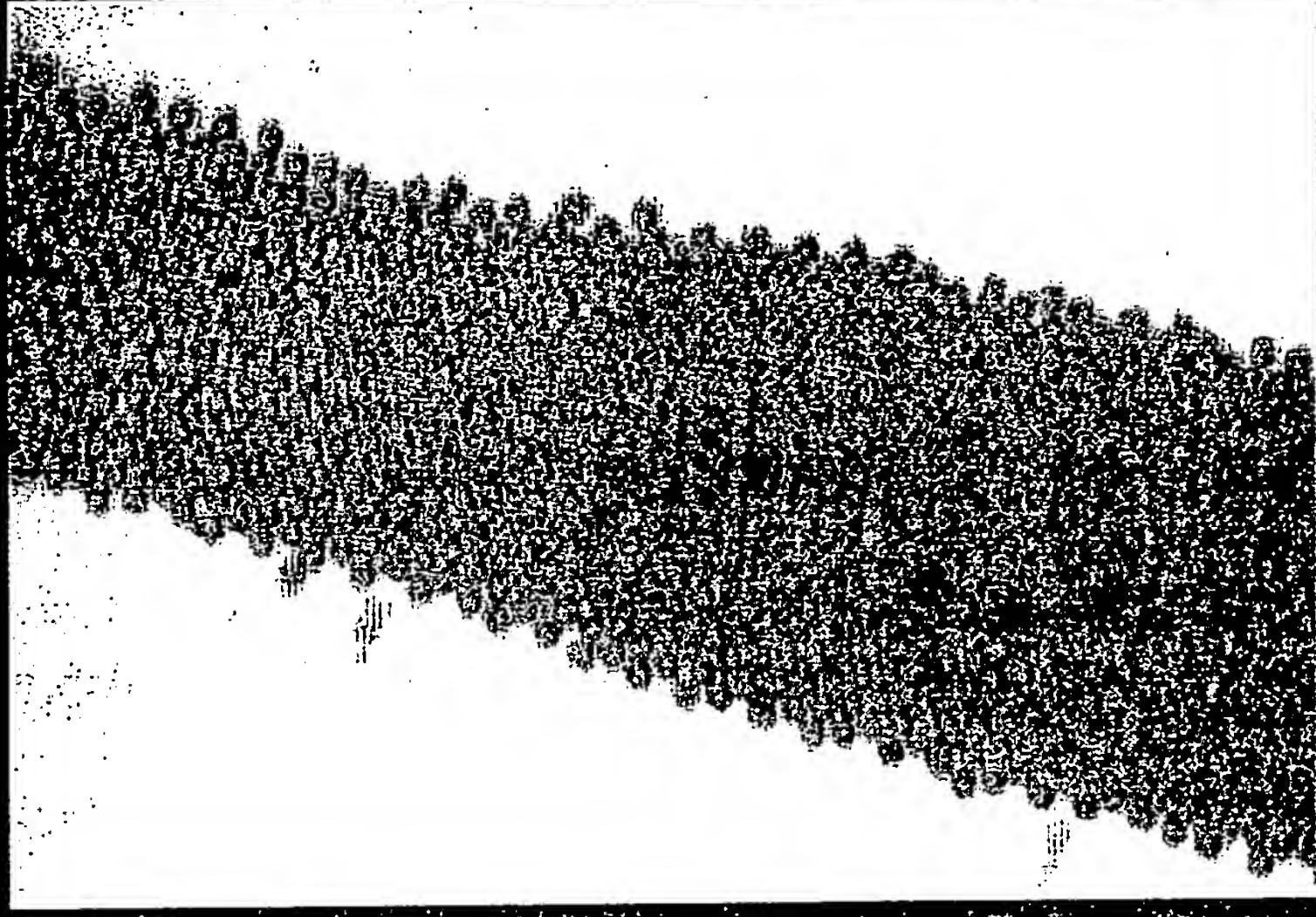
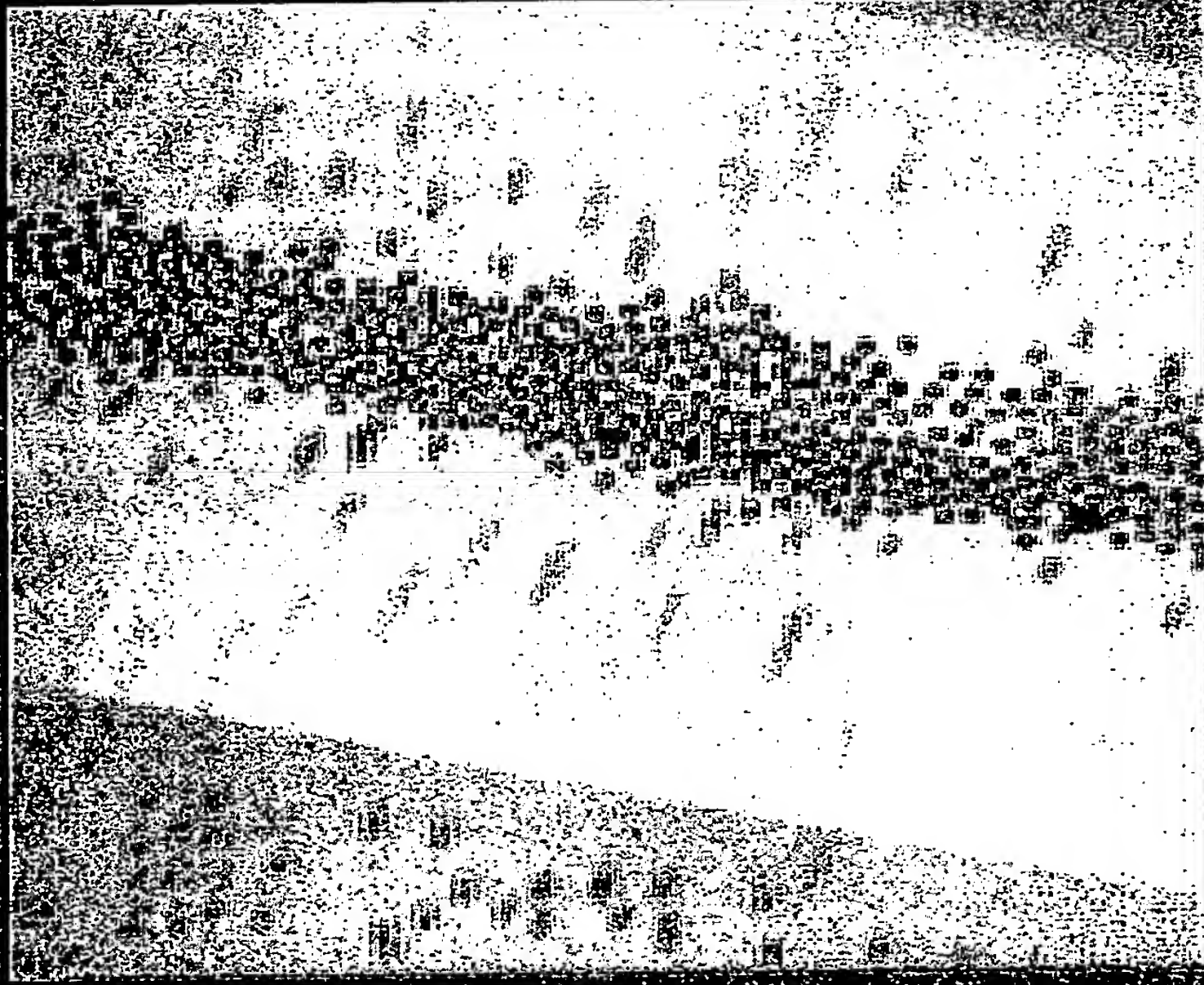
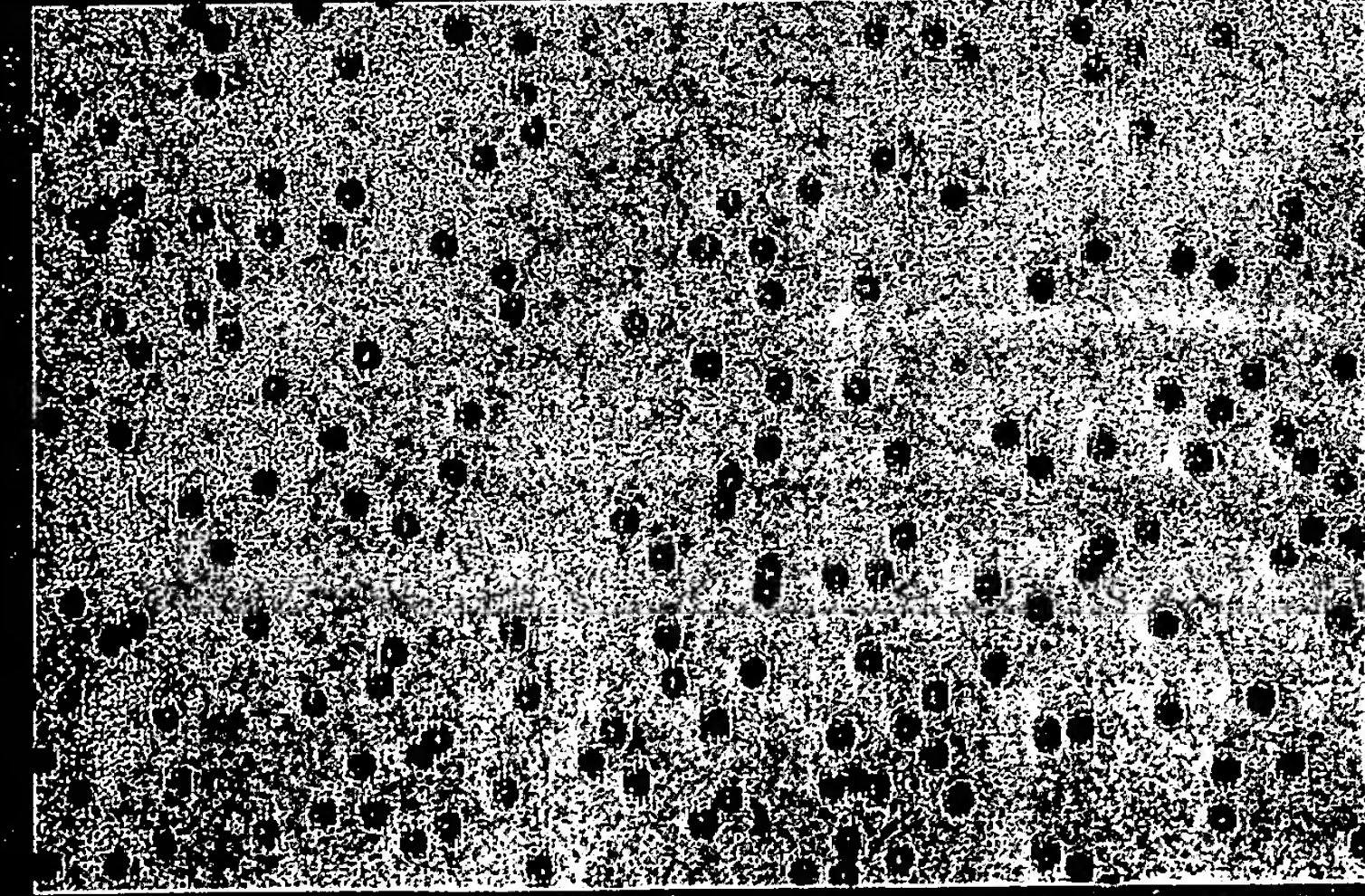
Simulation of Fluid Flow in Slot Geometry



Flow Rectification

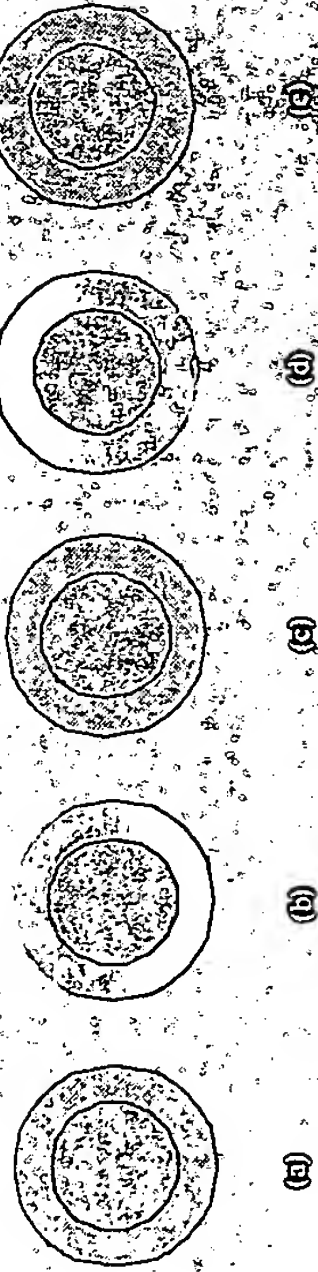


Array Assembly

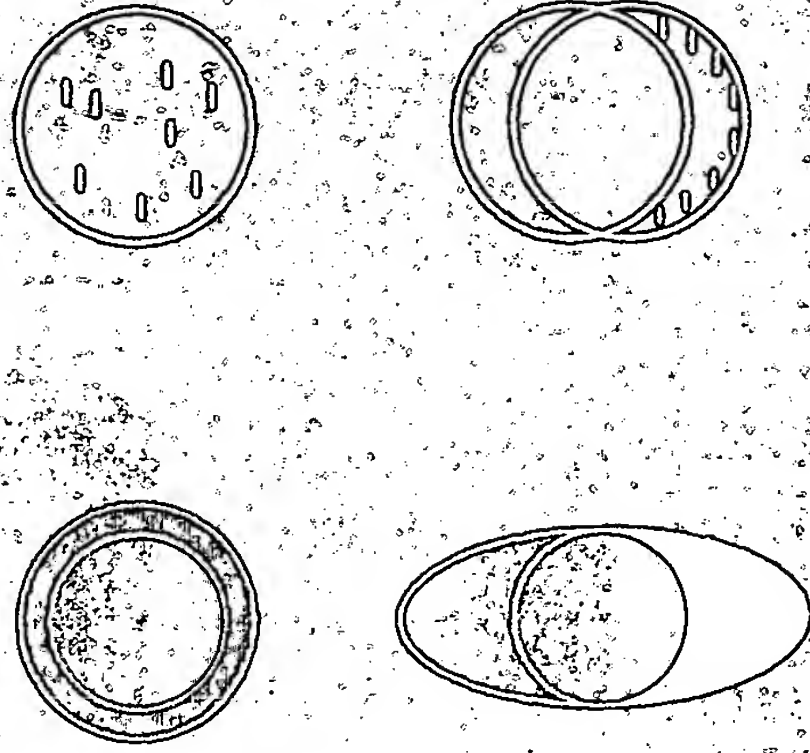


Bead Polarization

$$\omega t = 0 \quad \omega t = \pi/2 \quad \omega t = \pi \quad \omega t = 3\pi/2 \quad \omega t = 2\pi$$

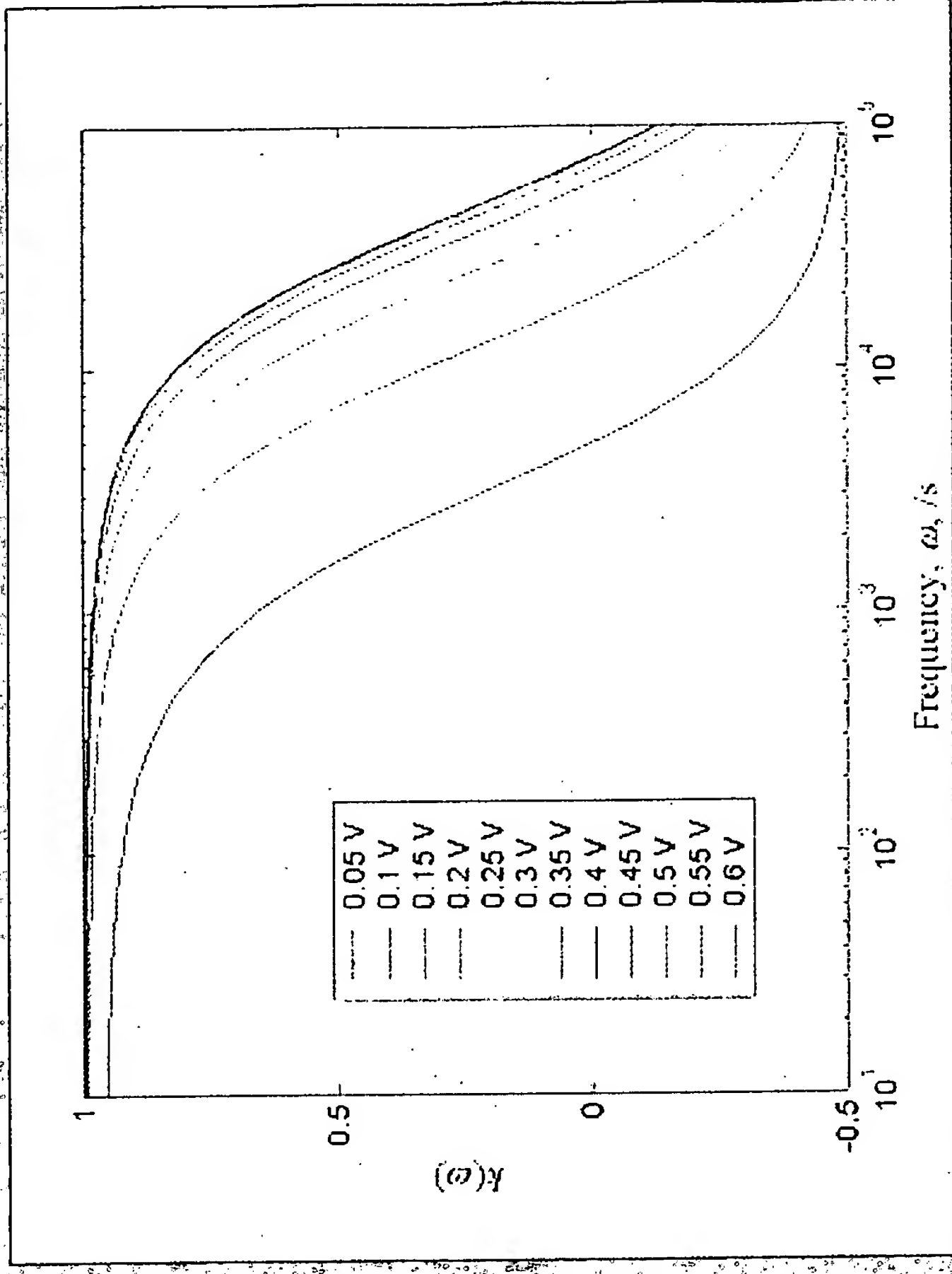


$$E_{ex} = E_0 \sin(\omega t)$$



|

$$\omega_R \approx \frac{DK^2}{(1+aK)^2} = \frac{K^2}{(1+aK)^2} (k_B T / e m)$$



$$k(\omega) = (\epsilon_s(\omega) - \epsilon_m) / (\epsilon_s(\omega) + 2\epsilon_m)$$